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régime, except that its scope was somewhat enlarged and steps were taken to clean out a drainage canal where anopheline larvæ had been found.

Fumigation and Disinfection of Infected Premises.

All buildings or dwellings considered infected were disinfected by the sanitary department, and when insanitary conditions existed which could not be removed by those living on the premises on account of poverty or other adequate reason, the work was done by the department. In other cases, the insanitary condition complained of was brought to the attention of the owner or tenant, a specified time for the abatement of the nuisance being specified, and on failure to comply therewith the fine or imprisonment provided for by the sanitary code was imposed. Printed forms were used for the notices above mentioned.

Deaths reported in Vera Cruz, 1913–1914 (Jan. 1 to Apr. 20).

	Malaria.	Tuberculosis.	Cerebrospinal meningitis.	Smallpox.	Total for month including stillbirths.	Stillbirths.
1913.						
January	16	27			148	11
February	8	27		1	151	9
March	5	35			140	4
April	5	26		3	128	8
May	9	29		5	149	5
June	10	31		4	141	13
July	19	23	3	1	151	7
August	14	29	1		157	13
September	14	16	5		133	11
October	22	23	3		162	19
November	19	30	3	3	163	10
December	16	27	20	1	192	2
Total	157	323	35	18	1,815	112
1914.						
January	6	27	6	2	180	17
February	5	22	3	2	123	12
March	5	23	3	23	177	9
April 1-20	9	22	6	10	127	10

SOLUBLE ALUMINUM COMPOUNDS.

THEIR OCCURRENCE IN CERTAIN VEGETABLE PRODUCTS.

By C. N. MYERS, Expert in Organic Chemistry, and CARL VOEGTLIN, Professor of Pharmacology, Hygienic Laboratory, United States Public Health Service.

During the last year the United States Public Health Service started an extensive investigation into the cause of pellagra. Among other questions studied, the relation of diet to this disease was given consideration. From a survey of the dietary peculiarities of countries in which pellagra is endemic, it seemed especially interesting to determine the effect of a mainly vegetable diet on the animal organism. For this purpose extensive feeding experiments on mice, rats, and other animals were carried on at the Hygienic Laboratory.[1]

Among other results the following was obtained: White mice, kept on an exclusive diet of corn, sweet potatoes, or certain other vegetable products, very often developed, in the course of a few days, well-defined toxic symptoms, soon followed by the death of the animal Preliminary experiments showed that the toxic material could be extracted from the corn. This extract produced similar toxic symptoms, when fed or introduced intravenously into normal animals. With these experiments as a basis, we began a study of the chemical character of the poisons involved in this intoxication. The first positive finding was the detection of relatively large amounts of soluble aluminum compounds in corn. This observation is certainly of considerable scientific and probably practical interest.

In order to make the study as complete as possible, samples of corn from nearly every State in the United States were examined, so that a fair average might be expected from a series of chemical analyses. In addition, as many samples of foreign corn as were available were analyzed. It should be stated that all of this corn was of good quality with a high percentage of germination. The percentage of metallic aluminum in this set of about 75 samples varied from 0.074 to 0.181 for whole corn grown in America. Corn in the form of meal, grits, hominy, etc., showed different values. These differences depend largely upon the method of milling employed, and upon what part of the kernel has been removed.

The products analyzed can be easily summed up in the following brief table expressed in per cent of aluminum:

Whole corn (American):	
Maximum	0.181
Mean	.120
Minimum	.074
Whole corn (foreign)	.165
Corn oil cake	.817
Corn meal	.178
Hominy	.145
Grits	.168
Oat meal	.175
Millet	.428
Rye	.273
Wheat flour	.045
Sunflower seed (hull removed)	.401
Cottonseed meal	.996
Banana (fresh; peel removed)	.033
Yams:	
Dried	.332
Fresh	.094

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[1] The results of this investigation will be published in due time.

Parsnips:	
Dried	0.306
Fresh	.053
Carrots:	
Dried	.301
Fresh	.036
Irish potatoes:	
Dried	.126
Fresh	.029

In the above table it is noticed that cottonseed meal has a very high percentage of aluminum, and wheat flour the least (for the dried material). In the case of the vegetables, the calculations were made upon the basis of both fresh and dried vegetables. Yams contain about 72 per cent of water, and carrots 88 per cent; thus it is seen that very large amounts of aluminum are present when calculations are made for the dried vegetables.

The question then arose, Is the aluminum present in a water-soluble form in these foodstuffs? It is obvious that only soluble aluminum may be absorbed from the gastro-intestinal canal. In order to investigate this phase of the subject a great many water extractions of the vegetables concerned were made, and the filtered extracts analyzed for aluminum. Among the foodstuffs examined were white potatoes—boiled in a manner similar to the method used by the housewife—sweet potatoes, carrots, parsnips, oatmeal, hominy, corn meal, etc. A second series of experiments was carried out by digestion with distilled water in a thermostat for 12 hours at 37° C. A third series of experiments was conducted with the same materials in the presence of 0.3 per cent hydrochloric acid (same as gastric acidity) in a thermostat for 12 hours at 37° C. In order to study the effect of baking on the solubility of the aluminum contained in corn, bread was made from corn meal which had previously been analyzed for aluminum. This bread was then submitted to water and weak hydrochloric acid extraction.

As a result of these four series of experiments it is found that at least 65 per cent of the aluminum present is soluble in water at 37° C. In the presence of hydrochloric acid (a condition prevailing in the stomach), the aluminum of corn, carrots, etc., is completely soluble On the other hand wheat flour and sunflower seed contain but a trace of soluble aluminum. In the case of one sample of corn which was previously analyzed, all of the aluminum present was soluble in weak hydrochloric acid. The following table shows examples of all series of experiments previously outlined.

	Total amount of aluminum in dry vegetable.	Aluminum soluble in H_2O after digestion for 12 hours at 37° C.	Aluminum soluble in 0.3 per cent HCl digested for 12 hours at 37° C.
	Per cent.	*Per cent.*	*Per cent.*
Corn (whole)	0.115	0.090	0.115
Carrots	.305	....	[1].312
Sweet potatoes	.332	....	.261
Cottonseed meal	.996	....	.718
Millet	.428	....	.171

[1] The carrots used for this determination were a little withered and undoubtedly the amount of dry material was greater than that found in previous water determination.

The corn meal which was used for the preparation of the corn bread contained 0.217 per cent of aluminum. Equal amounts of this meal were baked to various degrees of brownness (light, medium, and dark).

A sample of light brown bread yielded on extraction with water for 12 hours at 37° C., 0.169 per cent aluminum.

A sample of medium brown bread yielded on extraction with 0.3 per cent HCl for 12 hours at 37° C., 0.197 per cent aluminum.

A sample of dark brown bread yielded on extraction with 0.3 per cent HCl for 12 hours at 37° C., 0.201 per cent aluminum.

Discussion and Conclusions.

The presence of aluminum in cereals and in vegetables has received little attention from investigators who had occasion to study the inorganic constituents in the ash of these products. Reference is made here to the bibliography by Langworthy and Austen on the "Occurrence of aluminum in vegetable products, animal products, and natural waters." From an examination of the data given in this paper it will be seen that certain cereals and vegetables which are consumed in relatively large quantities by man, contain considerable amounts of soluble aluminum compounds (corn, sweet potatoes, carrots, etc.). On the other hand, some cereals, such as wheat for example, which are also consumed in relatively large amounts, contain aluminum in a mainly insoluble form. It is not the purpose of this preliminary communication to discuss the significance of the occurrence of soluble aluminum salts in the food of man, nor do we claim at present any relation between these findings and the etiology of pellagra. These questions are, however, under consideration. A few references to the biological importance of aluminum salts may, however, not be out of place. Gies and his coworkers have shown that, when soluble aluminum salts are administered to animals, they are absorbed, a fact which was corroborated in this laboratory, inasmuch as cows' milk, bought on the open market, showed, on analysis, 0.16

per cent of aluminum. According to Langworthy and Austen human milk also contains small quantities of aluminum. Thus it is evident that the aluminum had to be absorbed from the gastrointestinal canal in order to be secreted with the milk.

Toxic symptoms have been described by various investigators who have studied the effect of the soluble aluminum salts on animal bodies. To determine whether the quantities found in human food have any deleterious effects on man will necessitate considerable further research. The chemical constitution of the aluminum compounds contained in these vegetable products is under investigation.

In conclusion, it may be said that aluminum is present in certain foods in rather large quantities in a water-soluble form, and that the daily consumption of aluminum on a mainly vegetable diet may assume large proportions.

We are indebted to Mr. Hartley, of the Bureau of Plant Industry, for many of the samples of corn used in this investigation. Some of the foreign corn was obtained through the courtesy of Dr. C. H. Lavinder, of the United States Public Health Service.

PLAGUE IN HAWAII.

WITH SPECIAL REFERENCE TO ITS OCCURRENCE ON THE NORTHERN COAST OF THE ISLAND OF HAWAII.

By GEORGE W. McCOY, Surgeon, United States Public Health Service, and Sanitary Adviser to the Governor of Hawaii, and DONALD S. BOWMAN, Chief Sanitary Inspector, Island of Hawaii, Territorial Board of Health.

In December, 1899, the first cases of plague known to have occurred in the Hawaiian Islands appeared in the Chinese quarter of Honolulu on the island of Oahu. The disease subsequently developed on the other important islands of the group. The first case to be recognized on Hawaii, the largest island, occurred early in February, 1900. The type of the disease wherever it appeared was bubonic, though a few cases of what was regarded as primary pneumonic plague occurred. Rat infection undoubtedly existed as the primary cause of the disease in all of the outbreaks, but there was no systematic rodent examination or rodent extermination in the earlier years, this being prior to the recognition of the rat as the essential agent in the spread of the bubonic type of plague. The disease was suppressed in each locality in which it appeared with the exception of the northern coast of Hawaii and in the city of Honolulu. Cases occurred from time to time in Honolulu up to July 14, 1910.

From Hilo, the chief city of the island of Hawaii, where the disease appeared in 1900, the infection spread along the line of commercial